

REMARKS

This paper is responsive to an Office Action mailed May 7, 2007. Prior to this response, claims 1-3 and 6-7 were pending. After amending claims 1-3 and 7, and canceling claim 6, and adding claim 21, claims 1-3, 7, and 21 remain pending.

In Section 1 of the Office Action, claims 1-3 and 6-7 have been rejected under 35 U.S.C. 112, second paragraph, as indefinite. In response, the claims have been amended to delete the word "metal".

In Section 2 of the Office Action claims 1, 3, and 6-7 have been rejected under 35 U.S.C. 102(b) as anticipated by Werkhoven et al. ("Werkhoven"; US 6,534,395). The Office Action states that Werkhoven discloses a substrate, a first barrier layer of W, a second barrier layer of W_n, TiN, TaN etc., and a Cu layer. This rejection is traversed as follows.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

In the description of Figs. 9 and 10, Werkhoven discloses an insulating layer 402, which may be TEOS, BPSG, or a "low k" dielectric (col. 15, ln. 47-55). An adhesion layer 430 of W lies on insulator 402. A metal nitride barrier layer 432 (W_n, TiN, TaN) lies on adhesion layer 430. A transition (graded) region of tungsten copper nitride [(WN_x)_yCu_z] 434 lies on barrier layer 432. A seed region 436, which comprises Cu, lies on the transition region 434.

In contrast, Applicant's claim 1 recites a substrate, a first barrier thin film of TiN, TaN, W, WN, or SiN on the substrate, a second barrier thin film of TiN, TaN, W, WN, or SiN on the first barrier, and a Cu film on the second barrier. Claim 1 does not recite a tungsten copper nitride $[(WN)_x(Cu)_y]$ film. Neither does claim 1 recite any kind of layer that must be interposed Cu layer and the second barrier thin film, as disclosed by Werkhoven.

Since (WN)Cu material is *not* mentioned as one of the eligible barrier thin film materials in claim 1, and since claim 1 recites the Cu film being deposited on the second barrier thin film of TiN, TaN, W, WN, or SiN (without any kind of intervening film), Werkhoven does not describe all the limitations of the claimed invention. Because Werkhoven does not explicitly describe every limitation of the claimed invention he cannot anticipate claim 1. Claims 3 and 7, dependent from claim 1, enjoy the same distinctions from the cited prior art.

In Section 3 of the Office Action claim 2 has been rejected under 35 U.S.C. 103(a) as unpatentable with respect to Werkhoven in view of Lopatin et al. ("Lopatin"; US 6,368,954). The Office Action acknowledges that Werkhoven does not disclose the claimed film thickness, but states that Lopatin discloses the recited barrier thickness, and that it would have been obvious to modify Werkhoven's barrier to have the thickness disclosed by Lopatin "in order to have the desired thickness to perform the desired function." This rejection is traversed as follows.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As

stated in MPEP § 2143, there are three requirements to establish a *prima facie* case of obviousness.

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck* 947 F.2d 488, 20 USPQ2d, 1438 (Fed. Cir. 1991).

Werkhoven describes his tungsten copper nitride [(WN_x)_yCu_z] layer 434 as a transition region. This is because he is transitioning from a metal nitride layer 432, to a Cu seed region 436 (col. 16, ln. 60-67). At col. 17, ln. 17 through ln. 21, Werkhoven discloses that the transition region should start with a 0% Cu content at the interface to the first nitride layer 432, and end with about a 50% Cu concentration at the interface to the seed layer 436. Explicit details of the deposition processes are described from col. 17 to col. 20.

In his description of Fig. 9, Lopatin discloses a barrier layer 401, which may be Ta, TiN, WN, TaN, Ta, and related silicide compounds, overlying a semiconductor wafer 200. A pre-seed layer 402 (e.g., Cu) is formed over the barrier layer 401 (col. 5, ln. 19 through col. 6, ln. 5).

The obviousness rejection appears to be based upon the assumption that Werkhoven discloses all the limitations of the claim 1. However, as noted above in response to the anticipation rejection, claim 1 does not recite a graded (WN)Cu barrier material. Neither does claim 1 recite a film (i.e., (WN)Cu) intervening between the second barrier (TiN,

TaN, W, WN, or SiN) and an overlying Cu film. With respect to the third *prima facie* requirement, even if it would have been obvious incorporate Lopatin's film thickness into Werkhoven's disclosure, that combination still fails to describe the substrate/first barrier/second barrier/Cu stack recited in claim 1. Claim 2, dependent from claim 1, enjoys the same distinctions.

With respect to the first *prima facie* requirement, the Office Action states that it would have been obvious to modify Werkhoven in light of Lopatin "in order to have the desired thickness to perform the desired function." However, the above-quoted assertion does not explain how a practitioner in the art could have modified Werkhoven's structure into one that does not require an intervening graded (Wn)Cu layer between a Cu film and a second barrier. That is, the assertion does not explain how the combination of Werkhoven and Lopatin teaches the invention of claim 1, as the combination fails to disclose all of the claimed invention limitations. As noted above in response to the third *prima facie* requirement, even when combined, Werkhoven and Lopatin fail to disclose all of the claimed invention limitations. Rather, to meet the first *prima facie* requirement, there must be an explicit teaching that shows an expert how Werkhoven's structure can be modified in light of a teaching disclosed by Lopatin. Such a *prima facie* case has not been made, simply because all the Applicant's claim limitations cannot be found in the combination of Werkhoven and Lopatin references.

Alternately, if the Examiner is relying upon the knowledge of a person with skill in the art to supply the modifications to the prior art lacking in the Werkhoven and Lopatin references, then additional evidence should have been provided. Notable, when the source or

motivation is not from the prior art references, "the evidence" of motive will likely consist of an explanation or a well-known principle or problem-solving strategy to be applied". *DyStar*, 464 F.3d at 1366, 80 USPQ2d at 1649. The Office Action has not supplied the source for inspiration that an artisan could use to modify Werkhoven structure into one that does not require a graded (Wn)Cu layer underlying a Cu film.

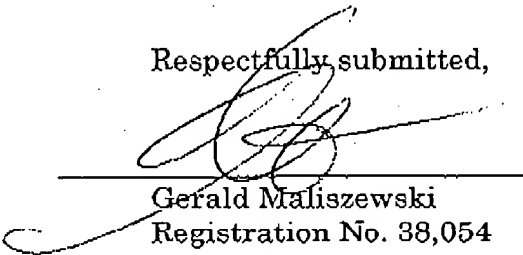
Considered from the perspective of the second *prima facie* requirement, even if a practitioner were given the Werkhoven and Lopatin references as a foundation, no evidence has been provided to show that there is a reasonable expectation of success in the claimed invention.

In summary, the Applicant respectfully submits that a *prima facie* case of obvious has not been supported in the rejection of claim 2.

It is believed that the application is in condition for allowance and reconsideration is earnestly solicited.

Respectfully submitted,

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